NRC PDR

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 4 1979

POOR ORIGINAL

Mr. Joel Yellin
Associate Professor
Center for International
Studies
Massachusetts Institute
of Technology
Cambridge, Massachusetts 02139

Dear Professor Yellin:

As requested by Mr. Harold R. Denton, I have reviewed your draft report, "Siting Nuclear Plants." We appreciate very much the opportunity to review your thoughtful analysis of remote siting policy issues. In general, we find agreement with the main thesis of your paper as to the desirability of developing more explicit policy on remote siting as one of the potentially useful approaches in reducing the adverse consequences of a class 9 accident. Indeed, certain goals of the Report of the Siting Policy Task Force (which Mr. Denton has already sent to you) express the need to encourage more isolated siting of nuclear power plants and identify criteria important to such policy formulations.

However, we find disagreement with the central philosophy of your paper that risk assessment methodology should not be based on the "arithmetic formula" (p. 10 of your report) of multiplying probabilities by consequences. Nor do we agree with your statement (p. 2) that "the potential consequences of a proposed technology deserve greater emphasis in risk assessment than do the associated probabilities. From the lessons learned in the Three Mile Island accident, we feel that greater emphasis is needed on both parts of the risk assessment formulation. Indeed, substantive recommendations were made by the Kemeny Commission report on the TMI accident which would require, to the "maximum extent feasible," the location of new power plants in areas remote from concentrations of population, but also a number of other measures designed to reduce the probability of class 9 accidents and their consequences. The NRC, in the enclosed report,* has expressed general agreement with these substantive recommendations.

*Preliminary Analysis and Views of the Nuclear Regulatory Commission on the Recommendations of the President's Commission on the Accident at Three Mile Island, NUREG-0632, November 9, 1979.

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Enclosed are some additional comments on your report prepared by several staff members. These comments provide more specific views on your approaches and analyses of issues which it is hoped will be of some benefit to you in your further efforts in preparing a final draft.

In our future staff deliberations in the development of siting policy which would explore the tradeoffs in benefits and costs in achieving greater site isolation, we would seek your comments at such time as public inputs are invited.

We are pleased to have had the opportunity to review your report and look forward to receiving copies of the final draft.

Sincerely,

Daniel R. Muller

Daniel R. Muller, Acting Director
Division of Site Safety and
Environmental Analysis

Enclosures:
As stated

DEC 4 1979

SOME SELECTIVE COMMENTS ON THE REPORT BY

YELLIN AND JOSKOW ON "SITING NUCLEAR POWER PLANTS"

1. A major thesis of the authors is that there should be explicit consideration of large accidents in reactor siting and that the NRC staff appears to be opposed to major changes in siting policy (see footnote No. 135). The authors should be aware that a recent NRC staff task force has recommended (Report of the Siting Policy Task Force, NUREG-0625, August 1979) major changes in siting policy to accomplish the following goals (p. iii):

   (i) To strengthen siting as a factor in defense in depth by establishing requirements for site approval that are independent of plant design consideration. The present policy of permitting plant design features to compensate for unfavorable site characteristics has resulted in improved designs but has tended to deemphasize site isolation.

   (ii) To take into consideration in siting the risk associated with accidents beyond the design basis (Class 9) by establishing population density and distribution criteria. Plant design improvements have reduced the probability and consequences of design basis accidents, but there remains the residual risk from accidents not considered in the design basis. Although this risk cannot be completely reduced to zero, it can be significantly reduced by effective siting.

   (iii) To require that sites selected will minimize the risk from energy generation. The selected sites should be among the best available in the region where new generating capacity is needed. Siting requirements should be stringent enough to limit the residual risk of reactor operation but not so stringent as to eliminate the nuclear option from large regions of the country. This is because energy generation from any source has its associated risk, with risks from some energy sources being greater than that of the nuclear option.

   Consequently, we expect, if the recommendations of the Siting Policy Task Force are implemented, that this aspect will address the major thesis of the authors.

2. The authors have, in addition, proposed that reactors be sited at distances of 50 to 150 miles from major population centers based upon:

   (i) the authors' estimates of reactor consequences which indicate that such distances minimize long-term consequences in the event of an accident.

   (ii) the authors' estimate of transmission costs which indicate that nuclear plants are not uneconomical at such distances, and

   (iii) the authors' belief that water availability is no problem.

A potentially controversial aspect of the authors' analysis is the estimation of reactor consequences. The authors' have rejected existing conventional consequence models as representing "simulations" and have chosen, instead, to rely upon their own "empirical" model based on certain data. The authors have not, however, compared and contrasted the results from their model with the conventional ones. Without a detailed and in-depth review of the bases for each competing model (which we also have not done) it is not possible to arrive at an objective evaluation that their proposed siting option is justified over other risk assessment models and cost-benefit methodologies.

3. The statement on page 26 that "the staff plans to recommend to the Commission, in accordance with an NRC-EPA report, that the consequences of major accidents not receive attention in emergency planning" mischaracterizes both the report referred to (NUREG-0396) and staff actions. Recognizing it is appropriate and prudent for emergency planning guidance to take into consideration the principal characteristics of a spectrum of design basis and core melt accidents, the Commission has recently endorsed this NRC/EPA task force report. (See enclosed NRC Policy Statement as published in the Federal Register, Oct. 23, 1979). This policy statement endorses the establishment of two Emergency Planning Zones (EPZs) around each nuclear power reactor. The EPZ for airborne exposure has a radius of about 10 miles; the EPZ for contaminated food has a radius of about 50 miles. These distances are considered large enough to provide a response base which would support activity outside the planning zone should this ever be needed.

4. Some comments on the models and underlying assumptions made by the authors in Chapter 2 are as follows:

   (i) The release assumptions are not based on any empirical evidence as claimed, and are the same type of extreme assumptions made in 1957 in the WASH-740 analysis.

   (ii) The biological response models are reasonable, but less precise and less empirical than WASH-1400 models.

   (iii) The atmospheric dispersion and deposition models are old and outdated, and for distances beyond a few tens of kilometers, less empirical than the models now in use (e.g., WASH-1400).

   (iv) In general, the assumptions (e.g., source terms) and methodology (e.g., meteorology) used are so simplistic that any relationship between these results and those of any other study would seem to be purely coincidental.

   (v) The deletion of release probability in defining a reasonable source term results in unrealistic estimates of risk.

Dated at Bethesda, Md. this 17th day of October 1979.

Robert M. Lazo,

Acting Chairman, Atomic Safety and Licensing Board Panel.

[FR Doc. 79-[illegible] Filed 10-22-79 8:45 am]

BILLING CODE 7590-01-M

[Docket No. 50-133]

Pacific Gas & Electric Co.; (Humboldt Bay Power Plant, Unit No. 3), Facility Operating License No. DPR-7; Reconstitution of Board

Edward Luton, Esq., was Chairman of the Atomic Safety and Licensing Board for the above proceeding. Mr. Luton has transferred to another federal agency.

Accordingly, Robert M. Lazo, Esq., whose address is Atomic Safety and Licensing Board Panel, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, is appointed Chairman of this Board. Reconstitution of the Board in this manner is in accordance with § 2.721 of the Commission's rules of practice, as amended.

Dated at Bethesda, Md. this 17th day of October 1979.

Robert M. Lazo,

Acting Chairman, Atomic Safety and Licensing Board Panel.

[FR Doc. 79-32[illegible] Filed 10-22-79 8:45 am]

BILLING CODE 7590-01-M

Planning Basis for Emergency Responses to Nuclear Power Reactor Accidents

AGENCY: Nuclear Regulatory Commission.

ACTION: NRC Policy Statement

Purpose

This is a statement of policy with regard to an Environmental Protection Agency (EPA) and Nuclear Regulatory Commission (NRC) task force report on guidance for use in state and local radiological emergency response plans at nuclear power plants.

Background

The NRC received a request from the Conference of Radiation Control Program Directors, an organization of State officials, to "make a determination of the most severe accident basis for which radiological emergency response plans should be developed by offsite agencies." In response, an EPA and NRC task force was established which prepared a report entitled "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," NUREG-0396, EPA 520/1-78-016, dated December 1978. Single copies of the report can be obtained by writing to the Director, Division of Technical Information and Document Control, Nuclear Regulatory Commission, Washington, D.C. 20555. The task force report was published for public comment in the Federal Register on December 15, 1978 and the comment period was extended to May 15, 1979 to allow additional comments resulting from the accident at Three Mile Island. A synopsis of the comments received and the task force consideration of these comments is available from the Assistant Director for Emergency Preparedness, Office of State Programs, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

Planning Basis

The major recommendation of the report is that two Emergency Planning Zones (EPZs) should be established around light water nuclear power plants. The EPZ for airborne exposure has a radius of about 10 miles; the EPZ for contaminated food has a radius of about 50 miles. Predetermined protective action plans are needed for the EPZs. The exact size and shape of each EPZ will be decided by emergency planning officials after they consider the specific conditions at each site. These distances are considered large enough to provide a response base which would support activity outside the planning zone should this ever be needed.

The report also provides planning basis guidance in the form of a range of time values in which emergency response officials should be prepared to implement protective action. The report indicates that, depending on such factors as the specific sequence of events during an accident which results in the release of radioactivity to the atmosphere and the prevailing meteorological conditions, protective action may be required from perhaps one-half hour to one day after the initiation of the accident. Development and periodic testing of procedures for rapid notification of emergency response officials is encouraged, since the time available for action is strongly affected by the time consumed in notification.

The chemical and physical characteristics of those radionuclides which contribute most significantly to human exposure are presented.

NRC Policy

NRC concurs in and endorses for use the guidance contained in the task force report. In endorsing this guidance, the Commission recognizes that it is appropriate and prudent for emergency planning guidance to take into consideration the principal characteristics (such as nuclides released and distances likely to be involved) of a spectrum of design basis and core melt accidents. While the Commission recognizes that the guidance may have significant response impacts for many local jurisdictions, it believes that implementation of the guidance is nevetheless needed to improve emergency response planning and preparedness around nuclear power reactors.

The Commission is directing its staff to incorporate the planning basis guidance into existing documents used in the evaluation of state and local emergency response plans to the extent practicable. The NRC has recently published and Advance Notice of Proposed Rulemaking concerning additional regulations on emergency plans. 44 FR 41484 Tuesday, July 17, 1979. Additional guidance will be provided following this rulemaking. This additional guidance can be expected to consider how local conditions such as demography, land use, and meteorology can influence the size an shape of the EPZs and to address other issues, such as evacuation planning.

Specific implementation dates for full implementation of the task force recommendations and any others that are developed will be established as part of the ongoing rulemaking effort. The Commission also expects the staff to assist state and local governments in improving their emergency response capabilities at existing sites in the immediate future.

Dated at Washington, D.C. this 18th day of October 1979.

For the Nuclear Regulatory Commission.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 79-32[illegible] Filed 10-22-79 8:45 am]

BILLING CODE 7590-01-M

Topical Report; Notice of Issuance and Availability

The Nuclear Regulatory Commission staff has released a topical report on the characteristics of lightning flashes. The report was prepared by the National Hurricane and Experimental Meteorology Laboratory of the National Oceanic and Atmospheric Administration for the NRC.

The report, NUREG/CR-1024, "An Initial Assessment of Flash Density and Peak Current Characteristics of Lightning Flashes to Ground in South Florida," presents information concerning the frequency and intensity

5. On page 2 of the Introduction, the authors "suggest that the potential consequences of a proposed technology deserve greater emphasis in risk assessment than do the associated probabilities." Their principal reason for this unorthodox view of risk assessment is that there are special circumstances surrounding the nuclear industry in which major damage may be caused to the fabric of society itself. The social costs of a Class 9 accident would, of course, be severe and should be given due weight as consequences along with economic costs and personal or individual costs. However, it is very objectionable to ignore or deemphasize the probabilities associated with these consequences for the following reasons:

(i) The overwhelming body of literature dealing with decisionmaking under uncertainty treats risk as the product of consequences times their associated probabilities which are then aggregated and weighed against the expected benefits from the proposed action.

(ii) A line-by-line comparison of risks, costs and benefits of the proposed action with its realistic alternatives is made possible only when the associated probabilities of the consequences are properly included inasmuch as alternatives will ususally have significantly different probabilities associated with the various consequences.

(iii) A deemphasis of the probabilities associated with grave social and economic consequences would deprive the very logic for deciding on continued improvements in safety technology (including human factors) that would reduce probability of those consequences associated with Class 9 accidents or, indeed, design basis accidents and those levels of radioactive emissions associated with normal plant operations.

(iv) Even if certain kinds of social consequences of a Class 9 accident were drastically reduced by locating plants in sparsely populated and remote regions, there would still remain the prospect of severe economic consequences for the consumers of electricity and financial

consequences for investors. The probability of these consequences needs to be given appropriate weight in regulatory decisions concerning the siting, design and operation of nuclear plants.

(v) The implicit notion that the problems of public acceptance of the nuclear option would be solved by giving greater emphasis in risk assessment to certain social consequences than to the associated probabilities is open to serious question. The notion that rural lives and the fabric of rural society are less important to the potentially affected parties than for their urban cousins -- which is implicit in a deemphasis of attention to probabilities associated with a Class 9 accident -- runs its own risks of public acceptance for remote siting strategies: An appreciation of this concern is reflected in the current opposition to low and high level radioactive waste repositories proposed for siting or expansion in lightly populated rural areas. Only through a balanced consideration of consequences and their associated probabilities can a logical defense be made of the reasonability of regulatory decisions affecting choices among sites and technological options as it affects different segments of society.

6. On pages 3 and 4 of the Introduction, the authors state that the "emphasis on individual risks underlies regulatory efforts to make nuclear power safer" and that the "essence of social life, relations among individuals, plays no role in these risk assessments." The basis for such assertions was not dealt with in this report. Since regulatory policy decisions have been and continue to be based on both technical considerations and subjective judgments related to consequences, it is patently presumptive to assume regulatory decisionmakers have made safety-related decisions in complete ignorance or ascribing no weight to societal consequences other than individual risks. Indeed, the

commonplace use of "margins of conservation" in safety-related decisions by the NRC provides, by the same token, a tradeoff of sorts for societal consequences that have not been quantified or that resist quantification. Thus far, with relatively limited exceptions, it has been regulatory policy not to provide a formalized cost-benefit analysis or value-impact assessments as related to Class 9 accidents. The reasons for this policy are quite complex. However, there are two exceptions of especial note which deal with a formal analysis of the consequences of Class 9 accidents:

(i) Final Environmental Statement Related to Manufacture of Floating Nuclear Power Plants by Offshore Power Systems, NUREG-0502, Docket No. STN 50-437, Part III, December 1978. See also the companion study, Final Liquid Pathway Generic Study Report, NUREG-0440, February 1978.

(ii) Anticipated Transients Without Scram for Light Water Reactors, NUREG-0460, Vol. 2, Appendix XII (Value-Impact Analysis), April 1978.

It should be noted that analytical efforts to assess the economic and societal consequences of Class 9 accidents as reflected in the above studies are pioneering and that both inhouse efforts and contract research are being devoted to the improvement of the methodologies and the assessment of risks, costs and benefits. It is possible, in view of experience gained with the TMI accident, that insufficient attention has been given in these studies to impacts affecting the "Fabric of society" as well as other impact issues. See the enclosed paper by Miller Spangler on "Methodological Concepts and Issues Involving Psychic Costs and Benefits, Risk Perception, and Risk Aversion in the Use Management of Alternative Energy Sources," which appears in Volume II of Changing Energy Use Futures (Pergamon Press, 1979).

7. On page 7 the authors propose, among other items, setting "threshold" consequences that trigger special regulation of particularly hazardous industrial activities. It would be helpful to call their attention, in this regard, to the description of NRC policy and practices pertaining to the Section on "Hazardous Activities in Plant Vicinity" on p. 20 of the Report of the Siting Policy Task Force (NUREG-0625).

8. On page 7, in their alternative approach to nuclear siting, the authors propose, among other features, "placing a heavy burden of proof on those who propose a particular site to show, primarily through the use of empirical data, that the chosen policy objectives will be met." Again, on page 9, in recognition that "neither precision nor certainty in the achievement of safety goals is possible," their proposals "require instead that particularly hazardous industrial activities meet a high qualitative standard of proof that explicitly stated safety objectives will be met." This proposed treatment is deserving of a number of comments:

   (i) The concept of a "burden of proof," regardless of on whom the burden is placed, is a sterile and scientifically objectionable phraseology when directed to impact predictions that are basically and patently unprovable. Since the future cannot be proven ex ante, nor even all of the potential causal factors reliably identified -- much less perfectly and convincingly evaluated for all parties -- professional or expert judgment is indispensible in dealing with such matters.

   (ii) Nor is the primary use of empirical data in the formulation of such judgments necessarily an adequate approach in estimating or forecasting consequences of stated proposals since: some empirical data that would be relevant to such judgment may escape the attention of the estimator; gaps in empirical data may exist; or inappropriate weights may be assigned to the causative force of such empirical data upon which primary reliance is made.

(iii) The history of technological progress suggests that increased benefits at reduced costs are made available to society by "learning through doing." That is to say, it is often the empirical data made available through the implementation of policy decisions or project - related decisions which provide an improved basis for subsequent rounds of decisions regarding technological changes or implementation measures. Unless society is willing to proceed in certain technological developments in the absence of proof, the potential benefits of that technology will be denied to society. Much of great benefit in improving nuclear safety is likely to result from the experience gained in the Three Mile Island accident but these expected benefits are still not a provable matter but must be dealt with by competent professional judgment.

(iv) As for the notion that "qualitative standards of proof" should actually be used to determine that "explicitly stated objectives" have, ex post, been met, this could encounter considerable public controversy percisely because of the imprecision of quatitative standards or because of a basic lack of understanding by the lay public of the explicitly stated (technical) objectives or else lack of agreement over their desirability.

9. On pages 7 and 8, the authors describe four siting alternatives which, as characterized by the table on page 21, encompass the following ranges of distance from urban areas: (i) less than 25 miles, (ii) greater than 25 miles (but presumably less than 150 miles), (iii) minimum of 150-200 miles (but no maximum stated), and (iv) hundreds of miles. Aside from the overlapping nature of the latter two categories, in regard to the future development of remote siting policy it would appear that the second of these distance categories (namely, 25 to 150 miles) will prove to be of greatest strategic importance. Accordingly, such a range of distances would appear much too gross for policy

considerations and perhaps should be divided into 25-mile sub-intervals up to a distance from urban areas of at least 100 miles. Nor should a parametric analysis of siting alternatives in regard to safety impacts be limited only to distances from urban areas of a stated minimum size but due consideration also should be given to wind-rose patterns, present and projected population densities within concentric rings and sectors in closest proximity to the plant site, as well as transportation ease or difficulty of emergency evacuation.

10. On page 10, the authors call attention to the diversity of views in society between (i) those who feel the number of potential fatalities can be tolerated if their probability is sufficiently low, and that it is more "cost-effective" to use engineered safety features and emergency planning to reduce probabilities to "acceptable" levels than to site reactors further from population centers, (ii) those who will assert that while we do not live in a risk-less society, industrial activities which involve the possibility of catastrophic reactor accidents are simply unacceptable, and (iii) those who will insist that given the mere possibility of large numbers of fatalities, a restrictive siting policy is in order only if it can be implemented at a "reasonsble" cost, without unduly delaying socially valuable technological development. The authors go on to say that "the relative merits of these views cannot fairly and effectively be evaluated through a mechanical cost-benefit analysis" and, moreover, that their alternative procedure "recognizes the inherent differences in values underlying the nuclear debate..."

The authors recognition of the diversity of values and differences of views in safety, the need to evaluate them fairly and effectively, and that this can't be accomplished by a cost-benefit analysis that is reduced solely to mathematical formula are basically valid observations in their general form. However, the specifics of their approach such as the scope of impact issues

considered (or not considered) in evaluating siting policy options and the neglect of probabilities associated with consequences, the gross manner by which are characterized the various segments of society having diverse views on the acceptability of nuclear risks in relation to other costs and benefits including other technological options, and the lack of attention to ethical principles of decisionmaking based on criteria of what is fair and equitable (not only regarding the present generation but to further generations as well) are highly questionable aspects. For example, the authors fail to discuss how regulatory decisions should, if this is at all practicable, reconcile the views of those who find the possibility of catastrophic accidents of nuclear plants unacceptable (regardless of whether they are remotely sited or not) with the views of those who also are concerned about catastrophic nuclear accidents but prefer to make up their minds about the acceptability of the nuclear option by weighing such considerations as: safety and health in the light of proposed siting and technological designs and operating procedures as well as confidence in regulatory practices; a wide range of environmental, economic and social aspects; and their related concerns for similar risks, costs and benefits of other fuels for generating electricity both for their own welfare and that of their children and grandchildren. There are, indeed, significant segments of our society who are concerned about morbidity and deaths associated with coal-fueled electricity generation and such potential catastrophies as war over oil supply failures and the greenhouse effect due to the combustion of fossil fuels that could alter climate and inundate coastal cities with rising ocean levels. "Catastrophy", of course, can be viewed at the personal or individual level as well as the social level. Unchecked inflation of energy prices along with induced inflationary effects on the economy as a whole can be viewed as nothing short of catastrophic by numerous retired persons or other low-income groups. The problem of determining differences of values in society affecting energy policy is a most difficult one and subject to the dynamics of changes in both values

and the levels and kinds of information which feed them. Provocative questions have been raised by Aaron Wildavsky in his article, "No Risk Is the Highest Risk of All" (American Scientist, Jan.-Feb. 1979):

> Is it our environment or ourselves that have changed? Would people like us have had this sort of concern in the past? Imagine our reaction if most of modern technology were being introduced today. Anyone aware of the ambience of our times must be sensitive to the strong possibility that many risks, such as endless automotive engine explosions, would be postualted that need never occur, or, if they did, would be found bearable. Wouldn't airliners crash into skyscrapers that would fall on others, killing tens of thousands? Who could prove otherwise? Even today there are risks from numberous small dams far exceeding those from nuclear reactors. Why is the one feared and not the other? Is it just that we are used to the old or are some of us looking differently at essentially the same sorts of experience?

Our society is obviously engaged in some serious soul-searching regarding energy options and policies not only as a result of the TMI accident but also due to the recent Iranian developments and the unsettled, or uncertain, outlook for energy options with which to replace oil imports. Somehow these concerns need to be factored into a cost-benefit analysis and this will undoubtedly include numerous "non-mechanistic" elements in whatever approach is decided upon to make the benefits of the nuclear option more socially acceptable.

11. On page 33 the authors take the position that "further nuclear development appears desirable and is probably inevitable." They did not, however, isolate the considerations which lend support to these views. Yet, the specific character of the net benefits of nuclear power which would make it desirable and inevitable are of potential importance to the evaluation of technological options and the development of siting policy including the exploration of equity considerations regarding the diversity of values of different segments of the public and the appraisal of tradeoff strategies or mitigative measures.

12. In the Summary, the authors affirm that their analysis "suggests that siting 50 to 150 miles from city centers would reduce the consequences of major

accidents and would not damage the competitive position of nuclear power vis-a-vis conventional energy sources. Siting at hundreds of miles from cities would, however, make nuclear reactors uneconomic in comparison to coal-fired power plants." The basis for their economic comparisons in arriving at these conclusions appear to be limited to Chapter 3 (Costs of Electrical Power Transmission) and Chapter 4 (Siting Restrictions and Access to Cooling Water). In the narrow confines of this cost analysis, they conclude on page 39 that siting plants 50 miles further from load centers would (in 1977 dollars) increase nuclear-electricity generating costs by less than one mill/kWh and that siting plants 150 miles further would increase the cost of nuclear generation from 1 to 2 mills/kWh.

However, a number of dollar costs as well as environmental costs have been excluded from their analysis which should be part of a cost-benefit (or value-impact) comparison of siting policy alternatives:

(i) There are good reasons to believe that the dollar costs associated with the capital requi[redacted] nuclear plant itself will increase substantially with sites having greater remoteness from urban centers. (e.g., recruitment of less skilled or less productive workers at more remote siting plus costs of delay in construction schedules due to lags in the recruitment and training of workers when limited numbers of already skilled workers can be induced to work at remote locations).

(ii) By the same token, socioeconomic stresses on community services, housing, etc. in the vicinity of the site can generally be expected to be greater for more remote siting than, say, sites within a more comfortable commuting distance (say, 50 to 75 miles) from urban centers.

(iii) The dollar costs of transporting heavy reactor components to remote sites can generally be expected to be substantially greater involving cost penalties of millions of dollars, not to mention the potentiality for costs of delay when suitable highways need to be built, clearances on overpasses increased, etc.

(iv) Potential costs of construction delay may materialize due to the exercise of eminent domain or public controversy and court actions associated with longer transmission corridors possibly crossing nature preserves, public parks, and recreational or other land uses of unique value.

(v) Electric systems reliability would diminish significantly with longer transmission routes since a large majority of electrical outages are associated with transmission failures rather than forced plant shutdowns due to equipment failures. This could entail social costs as well as higher operating costs.

(vi) The environmental impacts would be greater due to longer transmission corridors. This would involve disruptions to terrestrial and aquatic biota, risks of soil erosion, lost agricultural productivity, and aesthetic impairments to certain kinds of related land or water uses.

(vii) The possibility of higher water costs for these regions where the least-cost available water sources are, say, within 25 to 50 miles of urban areas and more remote locations have streams with relatively limited low-flow volumes thus requiring low-flow augmentation reservoirs to be added with costs running into the tens of millions dollars plus the environmental disturbances of such reservoirs.

(viii) The desire in some regions to avoid increased thermal loading on some streams or rivers due to conflicts with water quality improvement programs to restore or enhance certain fishery or water recreational uses. For example, such considerations caused the State of New Hampshire to prefer the use of seawater as opposed to inland streams for the proposed Seabrook nuclear plant.

13. The two-and-one-half page chapter on "Siting Restrictions and Access to Cooling Water" has some other deficiencies or defects besides the ones cited above. On page 44 the authors state that unlike fossil-fired electric generators, nuclear plants reject substantially all their waste heat to circulating cooling water. While this is a true statement for nuclear plants and non-steam fossil plants (oil or gas), it is not true for coal-steam electric plants which are the principal options to baseload nuclear plants. Although thermal loadings of coal-fired plants on cooling waters are significantly less than for nuclear plants of equal capacity, they are nonetheless substantial. On page 45 it is said

that, if once-through cooling is abandoned, water availability cannot be a strong constraint on siting. This is not necessarily true. Evaporative water losses in the use of cooling towers, for example, are substantially greater than for once-through cooling. The cumulative impact of such losses in water availability by numerous cooling towers located on the same stream or river is of increasing concern in a number of regions. Aside from the reduced quantity of water available due to such evaporative losses, there can be significant adverse impacts on water quality due to higher salinities (i.e., total dissolved solids). On page 46 it is said that, in the Southwest, nuclear energy does not appear to be a cost-effective alternative to coal-fired plants. While the authors do not identify what parameters or factors should be part of the cost-effectiveness analysis, the NRC cost-benefit analysis for the proposed Palo Verde nuclear units west of Phoenix (see the FES) indicates that nuclear plants can be cost-effective options in the Southwest, although the dollar cost comparison with the coal option is appreciably narrowed so that dollar cost considerations are less controlling than perhaps other factors in this choice.

14. In Chapter 5 (page 63) the authors state that two "intermediate siting policies" (their Regions B anc C in Table 1) are particularly attractive and can be implemented at costs which do not significantly alter the relative economics of nuclear and coal-based electricity generation. Whether we agree with this conclusion or not, any perception by utilities of increased cost elements with remote siting such as the transmission costs outlined by the authors and the omitted cost considerations cited under item 12 above plus the increased uncertainties over these cost elements--not to mention their concern over regulatory delays regarding the additional environmental impacts--may have profound influence on the outcome of their nuclear versus coal decisions. Thus, if the nuclear option is desirable in the national interest as the authors assert, it would be helpful for an independent research effort such as theirs(with no obvious axe to grind)to explore how utilities or other investors perceive the relative merits of remote siting policy options in terms of business risks associated with the nuclear and coal options for generating electricity. Likewise, where States play active roles in power plant siting, some exploration of their assessments of the comparative penalties and benefits of remote siting options might also be useful.